WE CLAIM:

1. A method of monitoring consciousness of a sentient subject and automatically detecting whether the subject is in a transition from a conscious state to a less conscious state or vice versa, by reducing effects of frequency based changes in neurological data from the subject, said method comprising: (i) obtaining an EEG signal from the subject; (ii) performing a frequency based analysis of the EEG signal to obtain a frequency-based signal; (iii) performing a phase based analysis of the EEG signal to obtain a phase-based signal ; (iv) detecting by comparing the frequency based signal and the phase based signal whether the subject is in transition from said conscious state to said less conscious state or vice versa; and (v) providing a warning signal when said subject is in said transition to said conscious state.

2. The method according to claim 1 wherein said frequency based analysis includes depth of sleep analysis and said phase-based analysis includes at least one of optimized bicoherence, bispectrum or triple product analysis.

3. The method according to claim 2 wherein said depth of sleep analysis includes real-time optimized R&K analysis.

4. The method according to claim 1 wherein said step of detecting is augmented with optimized AEP analysis.

5. The method according to claim 1 further comprising a means for adapting to parameters specific to said subject including body mass index, age and sex of said subject.

6. A method of processing a non-stationary signal including segments having increasing and decreasing amplitude representing physiological characteristics of a sentient subject, said segments including portions in which said signal changes from increasing to decreasing amplitude or vice versa, said method comprising: (i) detecting each segment by determining time instants when a time derivative of said signal is substantially equal to zero; (ii) performing syntactic analysis for each segment including assigning height, width and error parameters; (iii) identifying noise segments present in said signal by comparing said width parameter to a preset threshold and said error parameter to said height parameter; (iv)

removing said noise segments by replacing each identified noise segment with a substantially straight line; (v) sorting the remaining segments into a plurality of wavebands based on their width parameters; and (vi) classifying said signal as belonging to one of predefined sleep states based on relative frequency of occurrence of said segments in said wavebands.

7. A method of monitoring physiological characteristics of a sentient subject comprising: applying a first surface electrode to said subject to provide a first electrical signal to a remote monitoring apparatus; applying a second surface electrode to said subject to provide a second electrical signal to said remote monitoring apparatus; monitoring quality of said first electrical signal; in the event of a degradation in said quality of first signal, automatically substituting said second electrical signal for said first electrical signal; in the event of a degradation in said quality of said second electrical signal and in said quality of said first electrical signal, providing a warning signal.

8. The method according to claim 7 wherein said second electrode is spaced from said first electrode.

9. An apparatus for processing a non-stationary signal including segments having increasing and decreasing amplitude representing physiological characteristics of a sentient subject, said segments including portions in which said signal changes from increasing to decreasing amplitude or vice versa, said apparatus comprising: (i) means for detecting each segment by determining time instants when a time derivative of said signal is substantially equal to zero; (ii) means for dividing said signal into said segments including data over three consecutive time instants when said time derivative is equal to zero; (iii) means for assigning to each segment, height, width and error parameters; (iv) means for identifying noise segments in said signal including means for comparing for each segment said width parameter to a preset threshold and said error parameter to said height parameter; (v) means for removing said noise segments including means for substituting a straight line connecting first and third time instants when the time derivative of said signal is substantially equal to zero and means for reassigning segments and their parameters after the substitution; (vi) means for sorting the remaining segments into a plurality of wave bands based on the value of their width parameter, each wave band being defined by upper and lower frequencies corresponding to lower and upper values for the width parameter respectively; and (vii)

means for classifying a time interval of the signal data as belonging to one of predefined sleep states based on relative frequency of occurrence of said segments in said wave bands.

10. The apparatus according to claim 9 wherein said time derivative is equal to zero when said signal changes its direction from positive to negative or from negative to positive.

11. The apparatus according to claim 9 wherein each height parameter is assigned by calculating an average of the signal's variations between the first and second time instants when the time derivative of said signal is substantially equal to zero, and the second and third time instants when the time derivative of said signal is substantially equal to zero.

12. The apparatus according to claim 9 wherein each width parameter is assigned by calculating an average time interval between any data point within the segment and a second time instant when the time derivative of said signal is substantially equal to zero, said intervals being weighted according to the signal's variation between each respective data point and an adjacent data point nearest to the second time instant when the time derivative of said signal is substantially equal to zero.

13. The apparatus according to claim 9 wherein said error parameter is assigned by calculating an average deviation between current signal data and past signal data over a signal time interval.

14. The apparatus according to claim 9 wherein said means for identifying noise segments includes means for testing each segment to determine if its width parameter is less than said preset threshold and its error parameter is less than its height parameter by at least a preset ratio.

15. The apparatus according to claim 9 wherein said means for reassigning repeats a procedure of reassigning segments and their parameters and said means for substituting performs a substitution until no noise segments are identified in said signal.

16. The apparatus according to claim 9 wherein said means for classifying includes means for comparing to a preset threshold values of weighted combinations of occurrences of said segments in said wavebands.

17. The apparatus according to claim 9 including means for detecting and processing artefact patterns in said signal, including one or more of: means for detecting flat intervals in said signal; means for detecting intervals in said signal having a relatively sharp slope, being intervals in which variation in said signal exceeds a first threshold over a time interval equal to or shorter than a second threshold; means for detecting intervals in said signal having a relatively narrow peak, being intervals in which the width parameter is equal to or less than a third threshold and the height parameter is equal to or greater than a fourth threshold; and means for detecting other non-physiological pattern in said signal, being combinations of segments having a width and height of one, the segments in the combination being less than the respective total duration and signal variation of the combination by at least preset ratios.

18. The apparatus according to claim 9 including means for detecting and processing wave patterns characterized by minimum amplitude and minimum and maximum durations, including: means for detecting a core interval of the wave pattern as a sequence of one or more segments which starts at a first time instant of a first segment when a time derivative of said signal is substantially equal to zero and ends at a second time instant of the last segment when a time derivative of said signal is substantially equal to zero, or starts at the second time instant of the first segment when the time derivative of said signal is substantially equal to zero and ends at a third time instant of the last segment when the time derivative of said signal is substantially equal to zero, with the total signal variation of at least the minimum amplitude, duration of at least a preset share of the minimum duration, less than the maximum duration and the maximum deviation from a monotonous change of at least a preset share of the total variation.

19. The apparatus according to claim 9 including means for detecting a start and end of a main wave of the wave pattern by subsequent comparison with a preset threshold of a deviation of the slope of respective components of segments preceding and following the core interval from the slope of the core interval, and means for updating the core interval if the deviation of the slope and maximum deviation from the monotonous change do not exceed respective preset thresholds, and a total updated duration is equal to at least a preset share of the minimum duration and is less than the maximum duration.

20. The apparatus according to claim 19 including means for detecting one or two side waves of the wave pattern by subsequent testing of sequences of combinations of segments preceding and following the main wave for the signal duration conditions.

21. The apparatus according to claim 9 wherein said means for sorting into a plurality of wave bands is based on the detected wave patterns.

22. The apparatus according to claim 9 wherein said means for classifying includes means for comparing to preset threshold values of weighted combinations of occurrences of said segments in said wave bands, artefact patterns and wave patterns.

23. The apparatus according to claim 9 including means for detecting periodic patterns with specified minimum and maximum frequencies, minimum amplitude and minimum number of waves including: means for selecting combinations of a specified number of segments; means or an assigning component for assigning for each combination, an average, minimum and maximum amplitude and an average, minimum and maximum period; means for testing if the average amplitude exceeds a specified minimum amplitude for a periodic pattern; means for testing if the maximum amplitude exceeds the minimum amplitude by not more than a specified ratio; means for testing if the frequency corresponding to the average period is equal to or greater than the minimum frequency of the periodic pattern and is equal to or less than the maximum frequency of the periodic pattern; means for testing if the maximum period for a combination of segments exceeds the minimum period by not more than a specified ratio; means for joining combinations of segments, which comply with the above criteria; and means for classifying a time interval of the signal data as belonging to one of predefined states on the basis of a comparison of the value of a weighted combination of durations of a plurality of wave bands, artefact patterns and wave patterns with a threshold which is set to a different value depending on the total relative duration of periodic patterns within the time interval.

24. The apparatus according to claim 10 including means for classifying a time interval of the signal data as belonging to one of predefined states on the basis of a comparison of the value of a weighted combination of durations of a plurality of wave bands, artefact patterns and wave patterns with a decision boundary which is set to a different value depending on the total relative duration of periodic patterns within the time interval, if the difference between the value and the decision boundary is equal to or greater than a specified

margin, or otherwise, on the basis of a comparison of this value with the respective value for the preceding or following time interval providing that that interval is already classified and the difference between the respective values is equal or less than the specified margin, or otherwise, if after subsequent passes through the data, an interval is still not resolved, on the basis of comparison of this value with a threshold which is set to a different value depending on the total relative duration of periodic patterns within the time interval.

25. A sensor for detecting position of an eye lid comprising: first means adapted to move substantially with said eye lid and relative to a reference component; and means for providing an electrical signal indicative of the position of said first means relative to said reference component, such that said signal includes a measure of position and/or degree of opening of said eye lid.

26. The sensor according to claim 25 wherein said first means and said reference component are electrically coupled such that said coupling provides said measure of position and/or degree of opening of said eye lid.

27. The sensor according to claim 25 wherein said first means and said reference component are provided by respective arms connected for relative movement.

28. The sensor according to claim 27 wherein said arms are pivotably connected to each other.

29. The sensor according to claim 27 wherein each arm includes a capacitive element arranged such that the extent of overlap between the arms determines the coupling between the capacitive elements.

30. The sensor according to claim 29 wherein each capacitive element includes one plate of a capacitor.

31. The sensor according to claim 29 including means for measuring capacitance between said capacitive elements.

32. A sensor according to claim 27 wherein each arm includes an inductive element arranged such that the extent of overlap between the arms determines the coupling between the inductive elements.

33. A sensor according to claim 31 wherein each inductive element include a coil.

34. A sensor according to claim 32 including means for measuring inductive coupling between said inductive elements.

35. Apparatus for processing a non-stationary signal including segments having increasing and decreasing amplitude representing physiological characteristics of a sentient subject, said segments including portions in which said signal changes from increasing to decreasing amplitude or vice versa, said apparatus including:

(i) a detector which detects each segment by determining time instants when a time derivative of said signal is substantially equal to zero;

(ii) a divider which dividing said signal into said segments including data over three consecutive time instants when said time derivative is equal to zero;

(iii) an assigning component which assigns to each segment, height, width and error parameters;

(iv) an identifier which identifies noise segments in said signal including a comparing component which compares which each segment said width parameter to a preset threshold and said error parameter to said height parameter;

(v) a removing component which removes said noise segments including a substituting component which substitutes a straight line connecting first and third time instants when the time derivative of said signal is substantially equal to zero and a reassigning component which reassigning segments and their parameters after the substitution;

(vi) a sorter which sorts the remaining segments into a plurality of wave bands based on the value of their width parameter, each wave band being defined by upper and lower frequencies corresponding to lower and upper values which the width parameter respectively; and

(vii) a classifier which classifies a time interval of the signal data as belonging to one of predefined sleep states based on relative frequency of occurrence of said segments in said wave bands.

36. The apparatus according to claim 35 wherein said identifying component includes a testing component which tests each segment to determine if its width parameter is less than said preset threshold and its error parameter is less than its height parameter by at least a preset ratio.

37. The apparatus according to claim 35 wherein said reassigning component repeats a procedure of reassigning segments and their parameters and said substituting component performs a substitution until no noise segments are identified in said signal.

38. The apparatus according to claim 35 wherein said classifying component includes a comparing component which compares to a preset threshold values of weighted combinations of occurrences of said segments in said wavebands.

39. The apparatus according to claim 35 including a first detecting and processing component which detects and processes artefact patterns in said signal, including one or more of:

a second detector which detects flat intervals in said signal;

a third detector which detects intervals in said signal having a relatively sharp slope, being intervals in which variation in said signal exceeds a first threshold over a time interval equal to or shorter than a second threshold;

a fourth detector which detects intervals in said signal having a relatively narrow peak, being intervals in which the width parameter is equal to or less than a third threshold and the height parameter is equal to or greater than a fourth threshold; and

a fifth detector which detects other non-physiological pattern in said signal, being combinations of segments having a width and height of one, the segments in the combination being less than the respective total duration and signal variation of the combination by at least preset ratios.

40. The apparatus according to claim 39 including a sixth detector and processing component which detects and processes wave patterns characterized by minimum amplitude and minimum and maximum durations, including:

a seventh detector which detects a core interval of the wave pattern as a sequence of one or more segments which starts at a first time instant of a first segment when a time derivative of said signal is substantially equal to zero and ends at a second time instant of the last segment when a time derivative of said signal is substantially equal to zero, or starts at the second time instant of the first segment when the time derivative of said signal is substantially equal to zero and ends at a third time instant of the last segment when the time derivative of said signal is substantially equal to zero, with the total signal variation of at least the minimum amplitude, duration of at least a preset share of the minimum duration, less than the maximum duration and the maximum deviation from a monotonous change of at least a preset share of the total variation.

41. The apparatus according to claim 40 including an eighth detector which detects a start and end of a main wave of the wave pattern by subsequent comparison with a preset threshold of a deviation of the slope of respective components of segments preceding and following the core interval from the slope of the core interval, and an updating component which updating the core interval if the deviation of the slope and maximum deviation from the monotonous change do not exceed respective preset thresholds, and a total updated duration is equal to at least a preset share of the minimum duration and is less than the maximum duration.

42. The apparatus according to claim 41 including a ninth detector which detects one or two side waves of the wave pattern by subsequent testing of sequences of combinations of segments preceding and following the main wave which the signal duration conditions.

43. The apparatus according to claim 35 wherein said sorter receives detected wave patterns.

43. The apparatus according to claim 35 wherein said classifier includes a component which compares to preset threshold values of weighted combinations of occurrences of said segments in wave bands, artefact patterns and wave patterns.

44. The apparatus according to claim 42 including a tenth detector which detects periodic patterns with specified minimum and maximum frequencies, minimum amplitude and minimum number of waves including:

a selecting component which selects combinations of a specified number of segments;

an assigning component which assigning for each combination, an average, minimum and maximum amplitude and an average, minimum and maximum period;

a first testing component which tests if the average amplitude exceeds a specified minimum amplitude for a periodic pattern;

a second testing component which tests if the maximum amplitude exceeds the minimum amplitude by not more than a specified ratio;

a third testing component which tests if the frequency corresponding to the average period is equal to or greater than the minimum frequency of the periodic pattern and is equal to or less than the maximum frequency of the periodic pattern;

a fourth testing component which tests if the maximum period for a combination of segments exceeds the minimum period by not more than a specified ratio;

a joining component which joins combinations of segments, which comply with the above criteria; and

a first classifying component which classifies a time interval of the signal data as belonging to one of predefined states on the basis of a comparison of the value of a weighted combination of durations of a plurality of wave bands, artefact patterns and wave patterns with a threshold which is set to a different value depending on the total relative duration of periodic patterns within the time interval.

45. The apparatus according to claim 44 including a second classifying component which classifies a time interval of the signal data as belonging to one of predefined states on the basis of a comparison of the value of a weighted combination of durations of a plurality of wave bands, artefact patterns and wave patterns with a decision boundary which is set to a different value depending on the total relative duration of periodic patterns within the time interval, if the difference between the value and the decision boundary is equal to or greater

than a specified margin, or otherwise, on the basis of a comparison of this value with the respective value for the preceding or following time interval providing that that interval is already classified and the difference between the respective values is equal or less than the specified margin, or otherwise, if after subsequent passes through the data, an interval is still not resolved, on the basis of comparison of this value with a threshold which is set to a different value depending on the total relative duration of periodic patterns within the time interval.

46. A sensor which detecting position of an eye lid including:

a movable component adapted to move substantially with said eye lid and relative to a reference component; and

a signal providing component which providing an electrical signal indicative of the position of said movable component relative to said reference component, such that said signal includes a measure of position and/or degree of opening of said eyelid.

47. The sensor according to claim 46 wherein said movable component and said reference component are provided by respective arms connected for relative movement.

48. The sensor according to claim 47 wherein said arms are pivotably connected to each other.

49. The sensor according to claim 47 wherein each arm includes a capacitive element arranged such that the extent of overlap between the arms determines the coupling between the capacitive elements.

50. The sensor according to claim 49 wherein each capacitive element includes one plate of a capacitor.

51. The sensor according to claim 49 including a measuring component which measures the capacitance between said capacitive elements.

52. A sensor according to claim 47 wherein each arm includes an inductive element arranged such that the extent of overlap between the arms determines the coupling between the inductive elements.

53. A sensor according to claim 52 wherein each inductive element include a coil.

54. A sensor according to claim 53 including a measuring component which measures the inductive coupling between said inductive elements.